Royal Netherlands
Meteorological Institute
Ministry of Infrastructure and the Environment

Satellite Detection of Absorbing Aerosols

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GEOPHYSICAL RESEARCH LETTERS, VOL. 25, NO.16, PAGES 3135-3138, AUGUS

Retrieval of Aerosol Optical Depth over Land using two-angle view Satellite Radiometry during TARFOX

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TNO Physics and Electronics Laboratory, The Hague, The Netherlands

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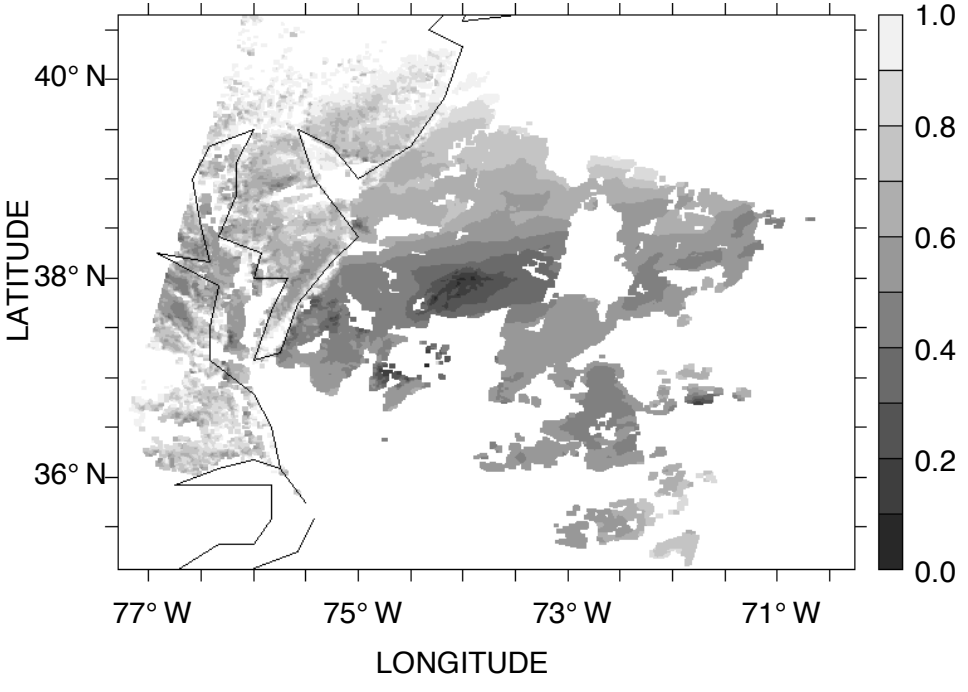
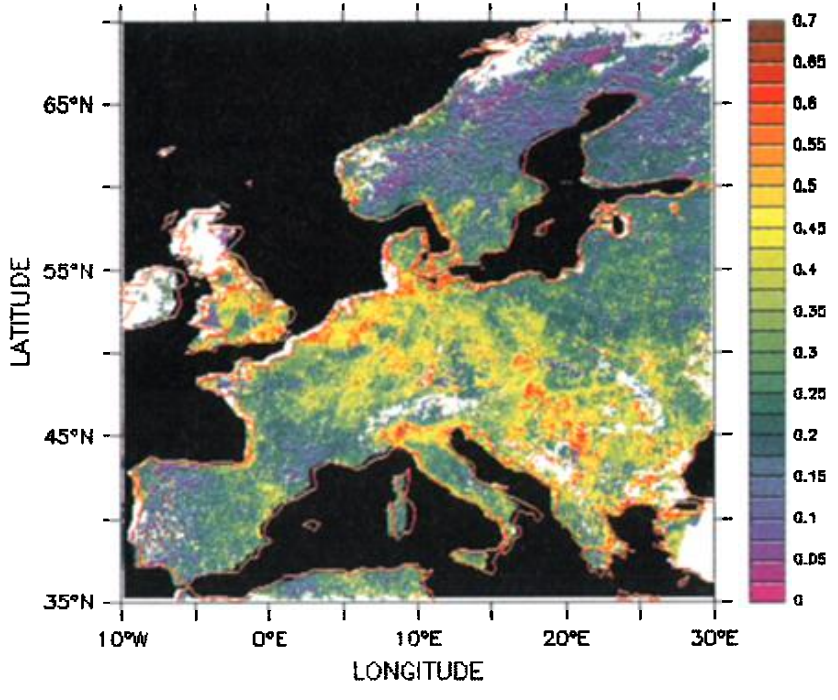
Naval Postgraduate School, Monterey CA, USA



GEOPHYSICAL RESEARCH LETTERS, VOL. 27, NO. 7, PAGES 955-958, APRIL 1, 2000

Aerosol optical depth over Europe in August 1997 derived from ATSR-2 data.

C. Robles Gonzalez, J. P. Veefkind [1] and G. de Leeuw
TNO Physics and Electronics Laboratory, The Hague, The Netherlands



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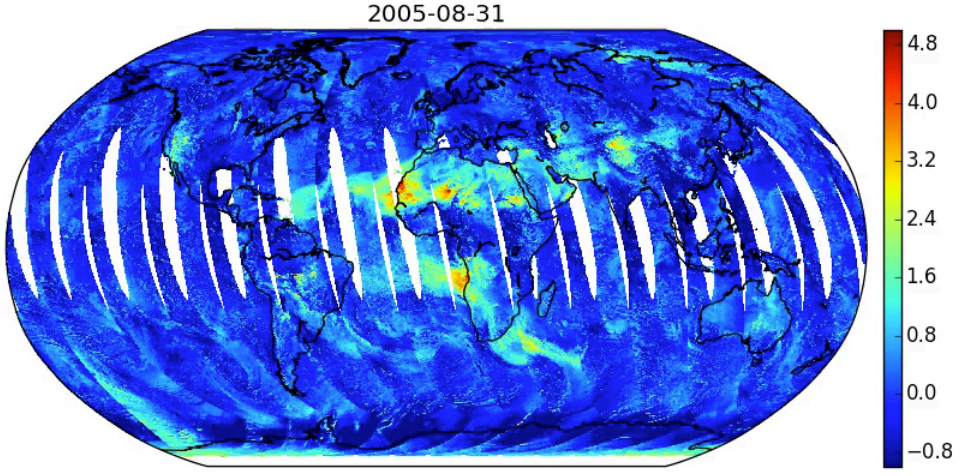
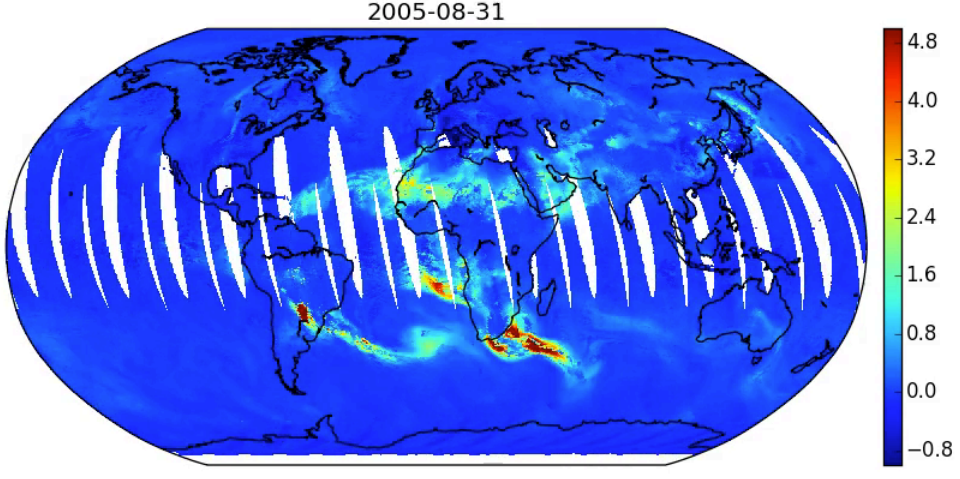
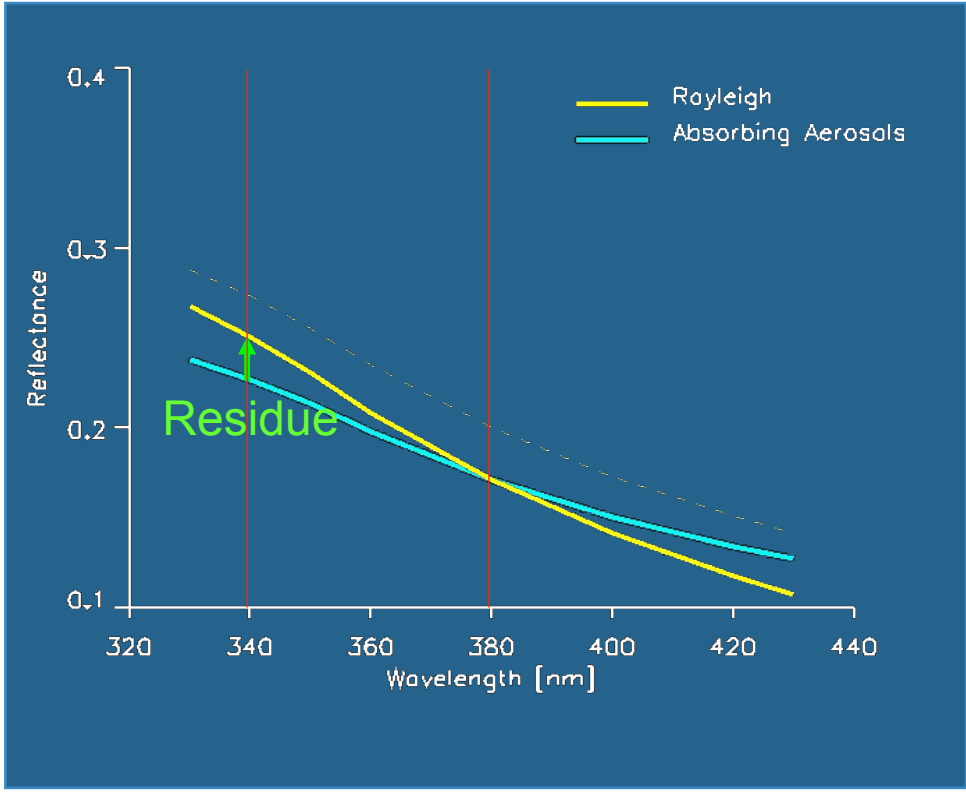


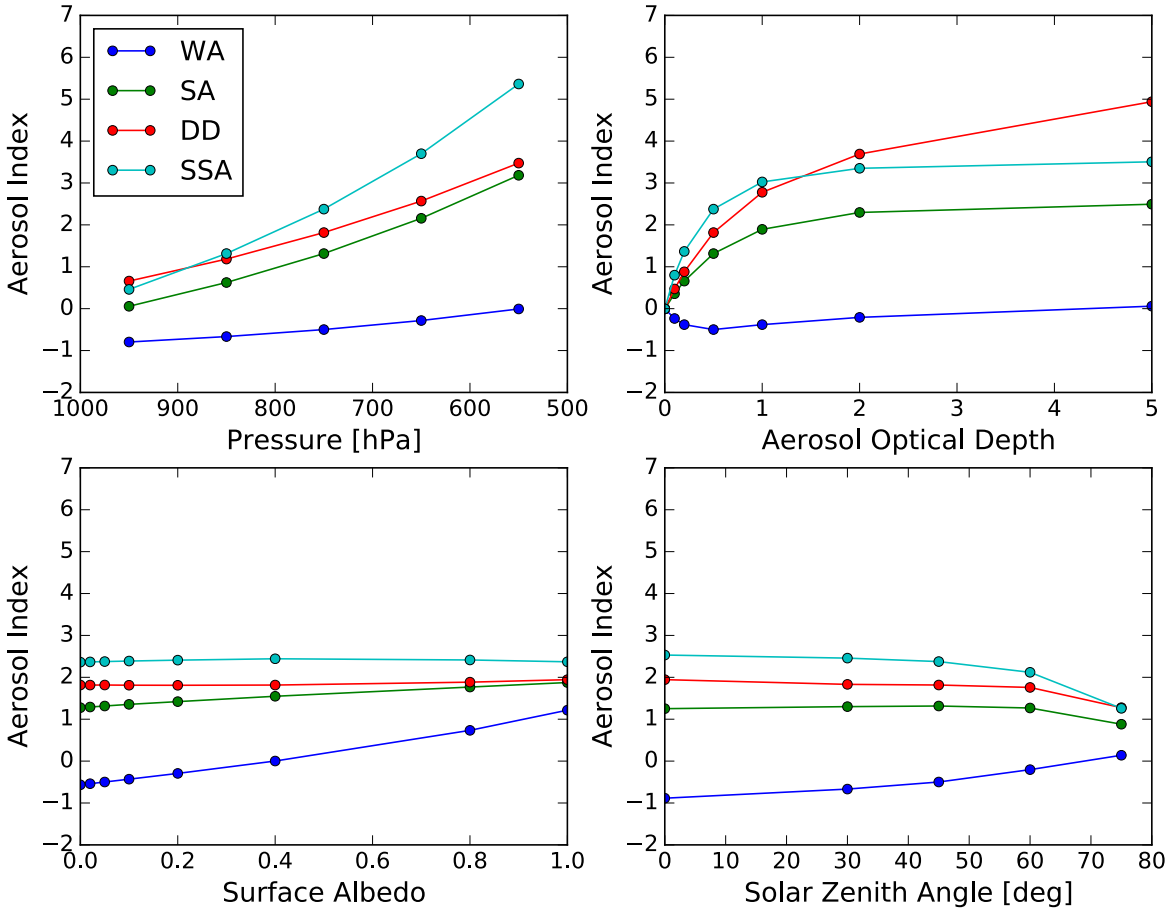


UV Aerosol Index

- Simple quantity derived from a wavelength pair in the UV (340 – 390 nm)
- Can be used to detect plumes of absorbing aerosol
- Advantage: simple algorithm, no a priori information, very long dataset, can be applied over clouds and bright surfaces.
- Disadvantage: not a geophysical quantity which makes quantitative interpretation challenging



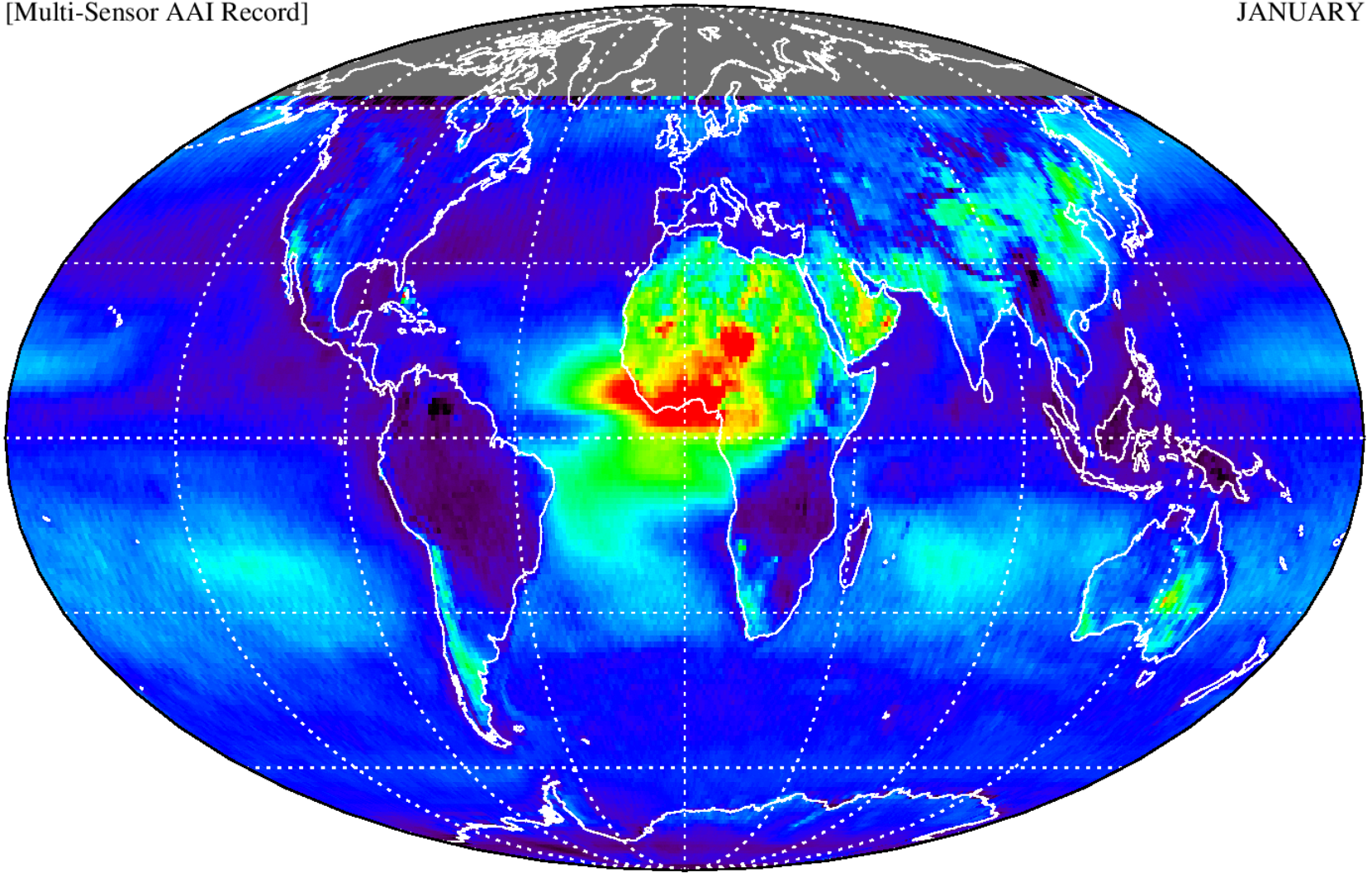
UV Aerosol Index Dependencies

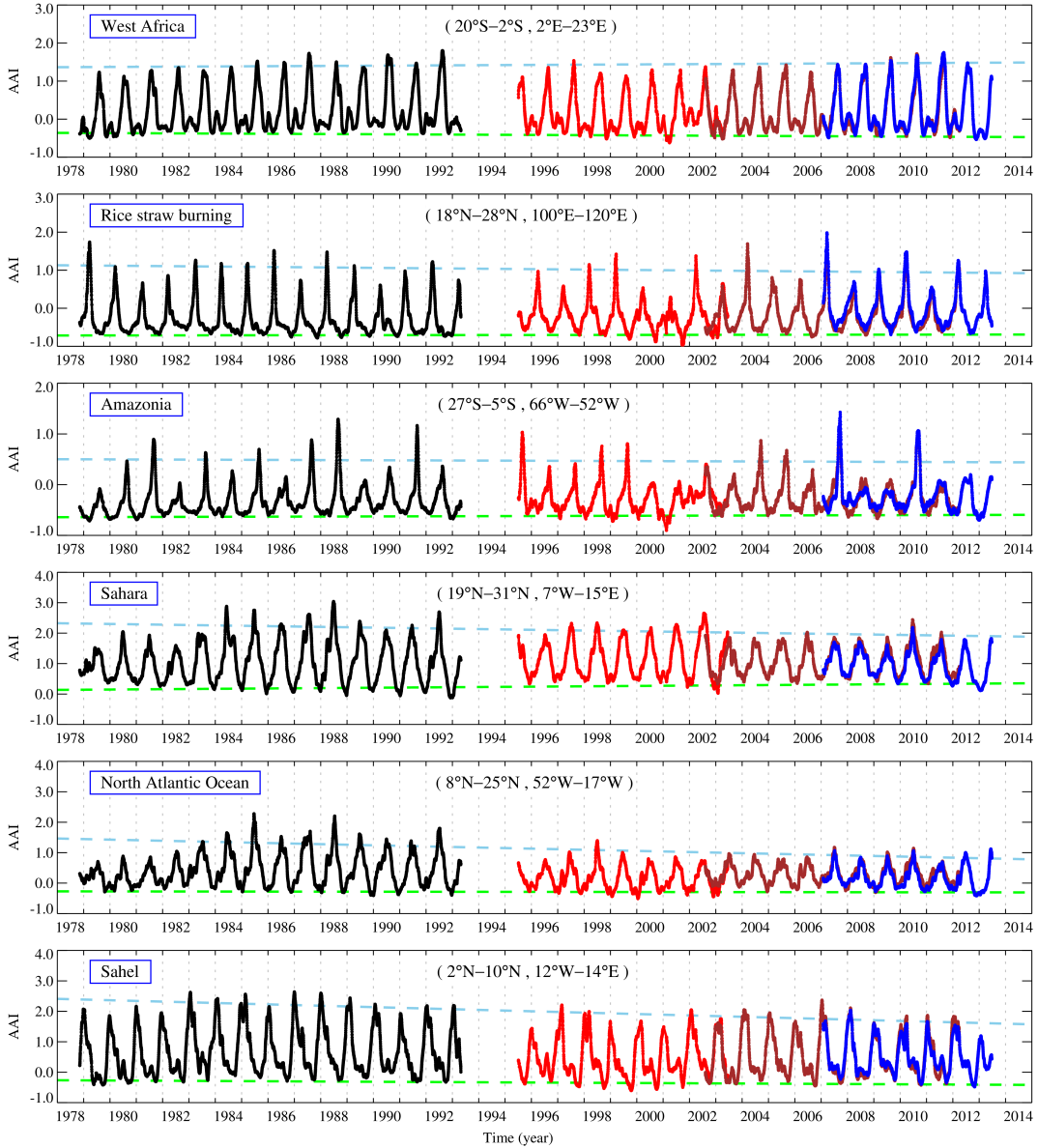


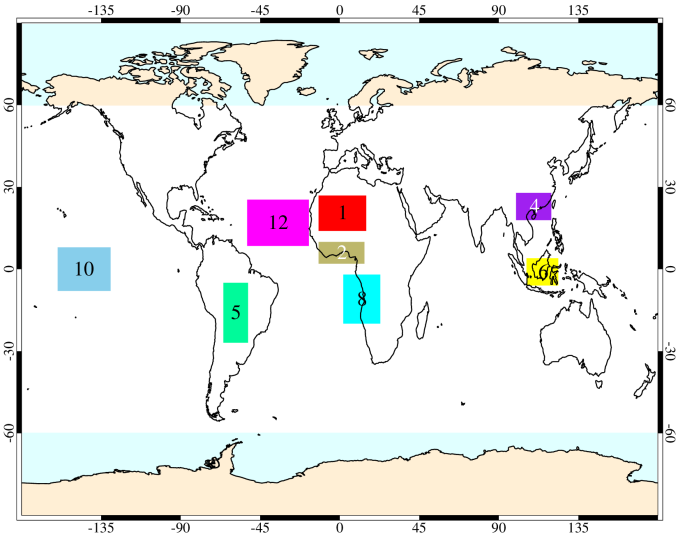
Multi Sensor AAI Product

	Wavelength pair (nm)	Equator crossing time	Pixel size (km)	Days needed for global coverage	Platform / Operation period
TOMS	360 / 331	12 : 00 LT	50 × 50	1	Nimbus-7 (1978 – 1993)
GOME–1	340 / 380	10 : 30 LT	320 × 40	3	ERS-2 (1995 – 2003*)
SCIAMACHY	340 / 380	10 : 00 LT	60 × 30	6	Envisat (2002 – 2012)
OMI	354 / 388	13 : 45 LT	13 × 24	1	Aura (2004 – present)
GOME–2	340 / 380	09 : 30 LT	80 × 40	1.5	MetOp-A/B (2007 – present)

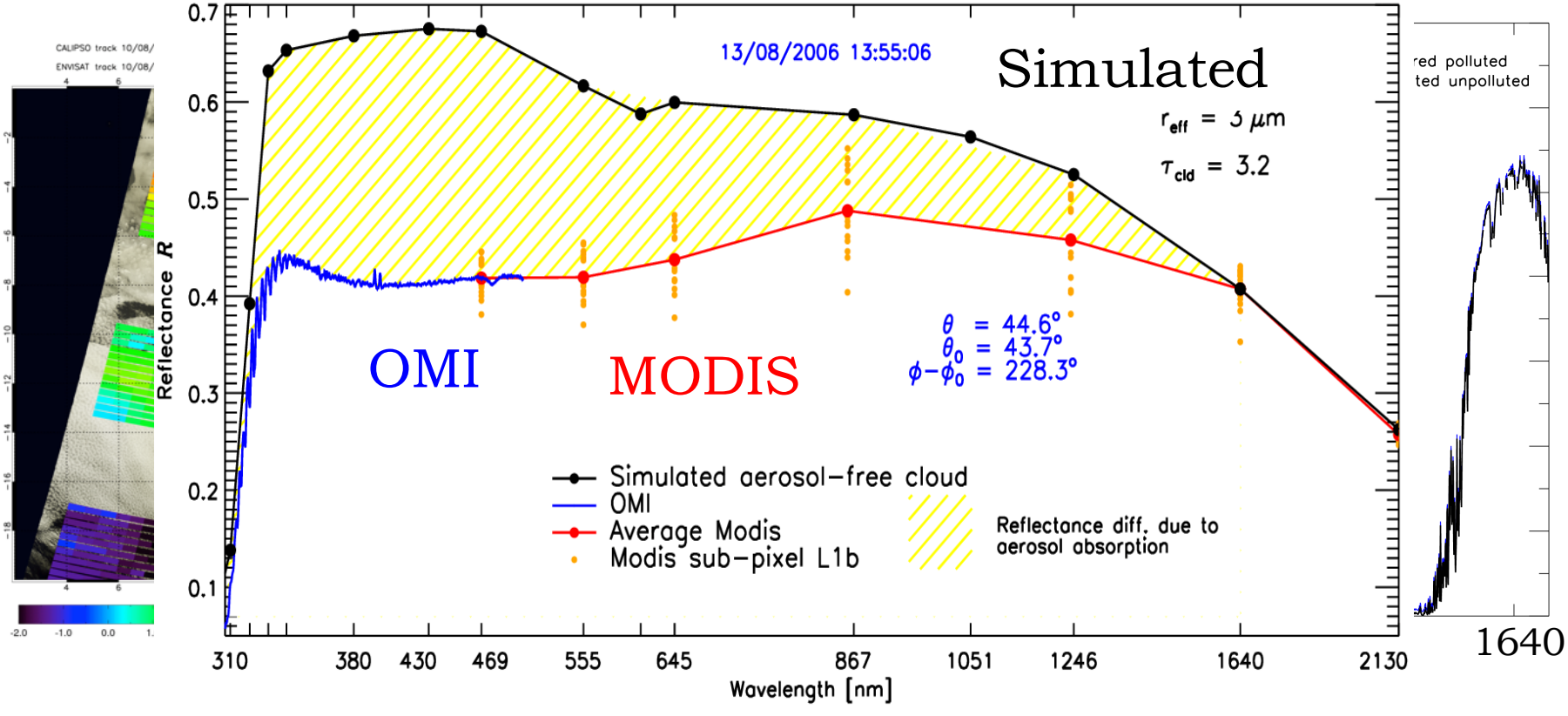
[Multi-Sensor AAI Record] JANUARY




West Africa
(20°S–2°S , 2°E–23°E)
Rice straw burning
(18°N–28°N , 100°E–120°E)
Amazonia
(27°S–5°S , 66°W–52°W)
Sahara
(19°N–31°N , 7°W–15°E)
North Atlantic Ocean
(8°N–25°N , 52°W–17°W)
Sahel
(2°N–10°N , 12°W–14°E)
AAI
Time (year)

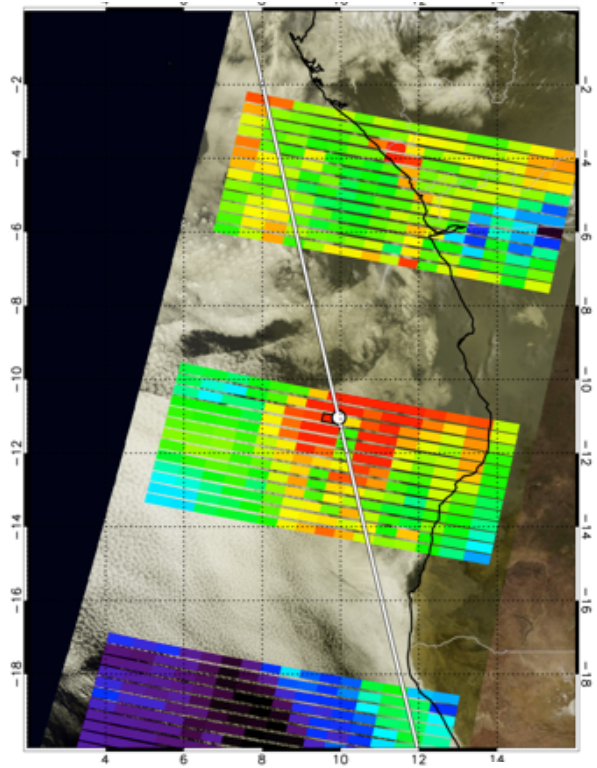

1
2
4
5
6
8
10
12

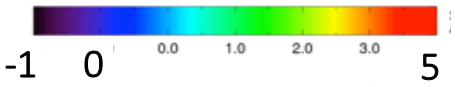
Differential Aerosol Absorption



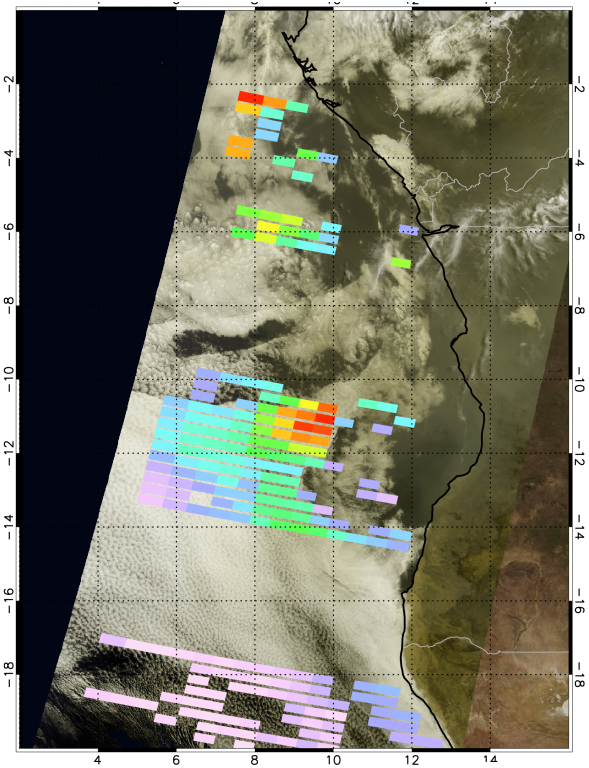
Southeast Atlantic Ocean *above cloud* observations

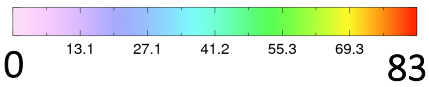
ENVISAT track 10 Aug 2006 09:10:26 – 09:16:38 UTC





AAI

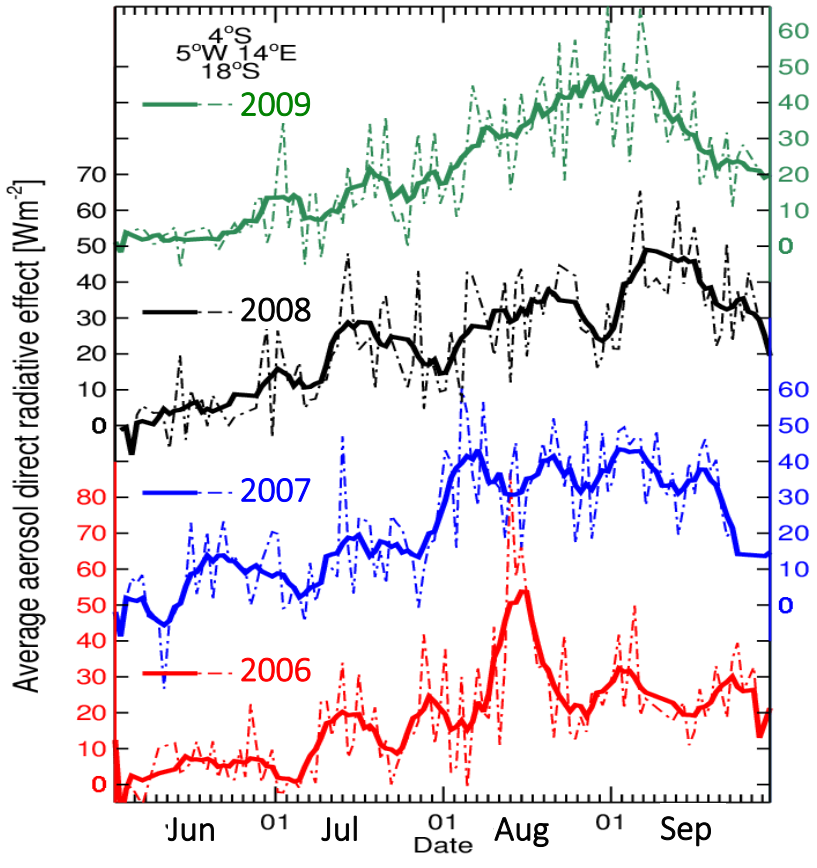


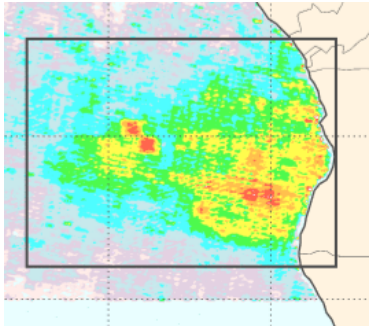


Aerosol DRE [Wm^{-2}]

De Graaf *et al.*, **2012**. JGR

Southeast Atlantic Ocean *above cloud* observations



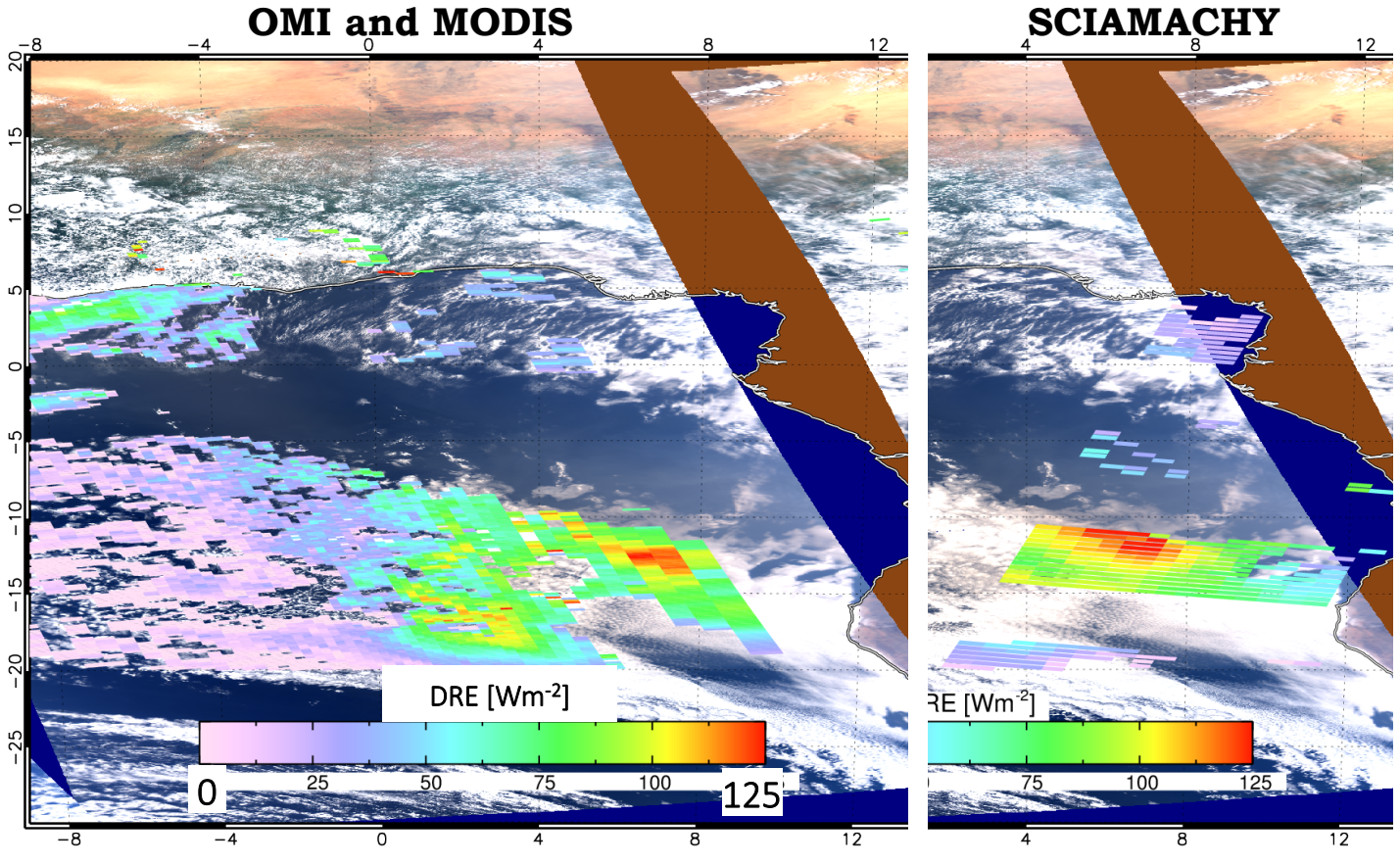


Aerosol DRE from SCIAMACHY averaged over the southeast Atlantic Ocean:

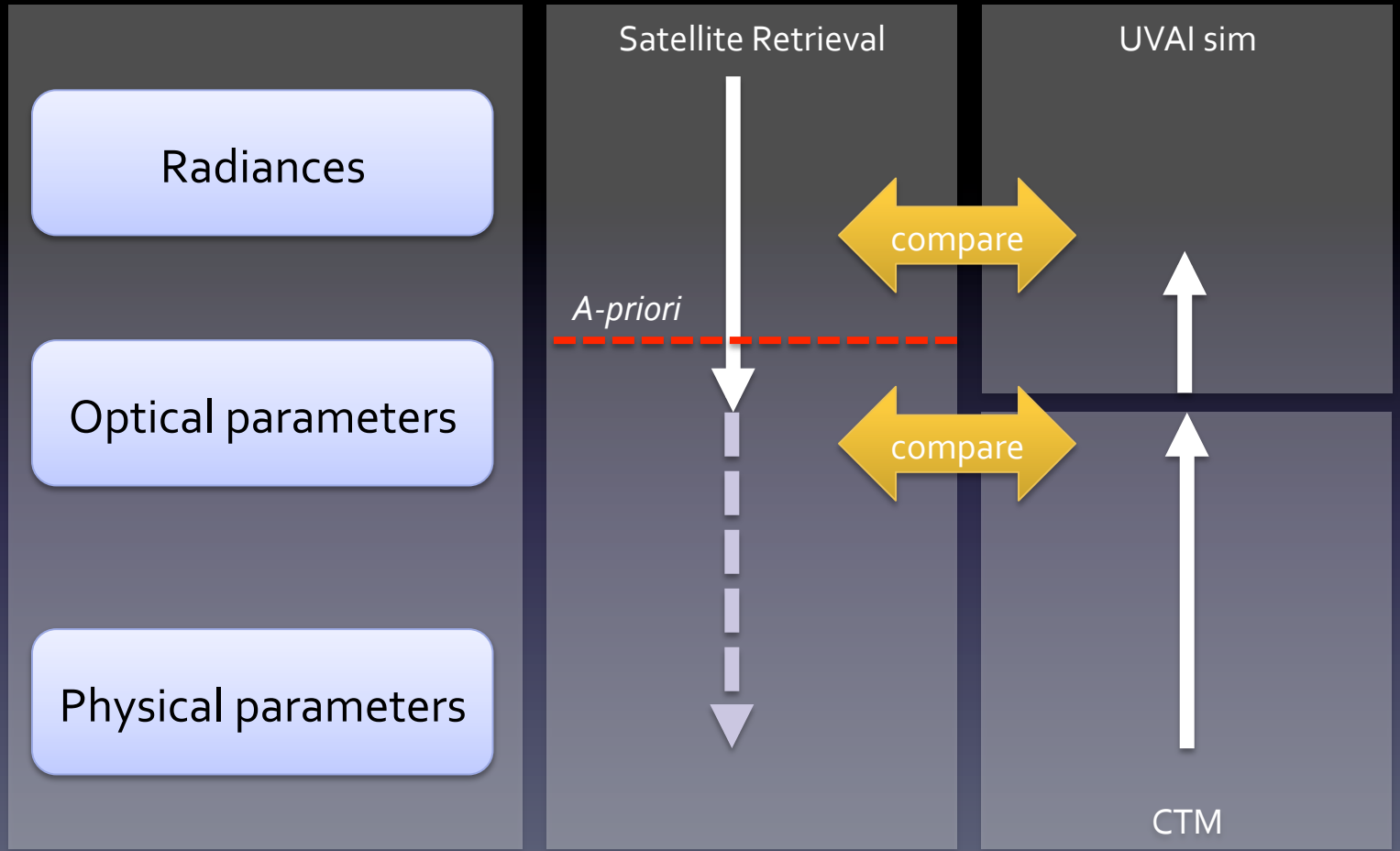
- 2006 was anomalous with extreme events
- High observed values are **not reproduced** by climate models

De Graaf *et al.*, 2014 GRL 41

Combining OMI and MODIS reflectances



AAI Simulator Concept



AAI Simulator

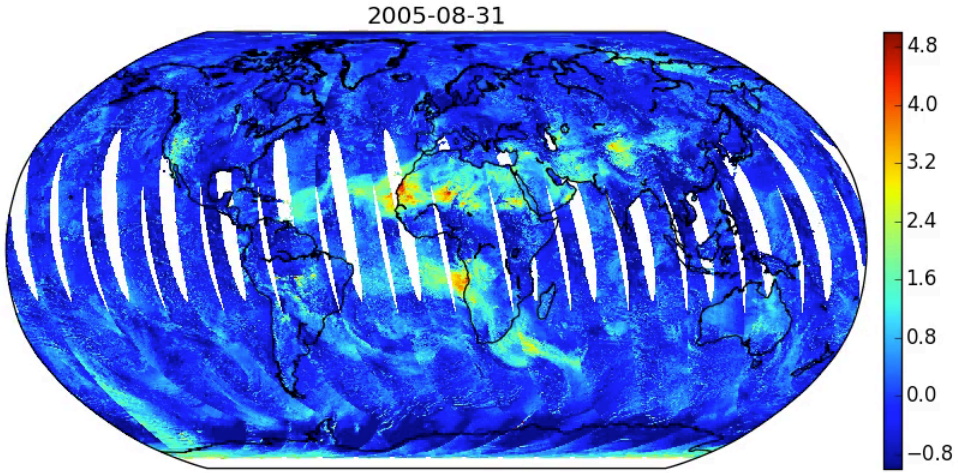
a tool to calculate AAI from CTM model fields

- Low CPU load
- Applicable to multiple CTMs
- Applicable to multiple satellite data sets
- Accurate

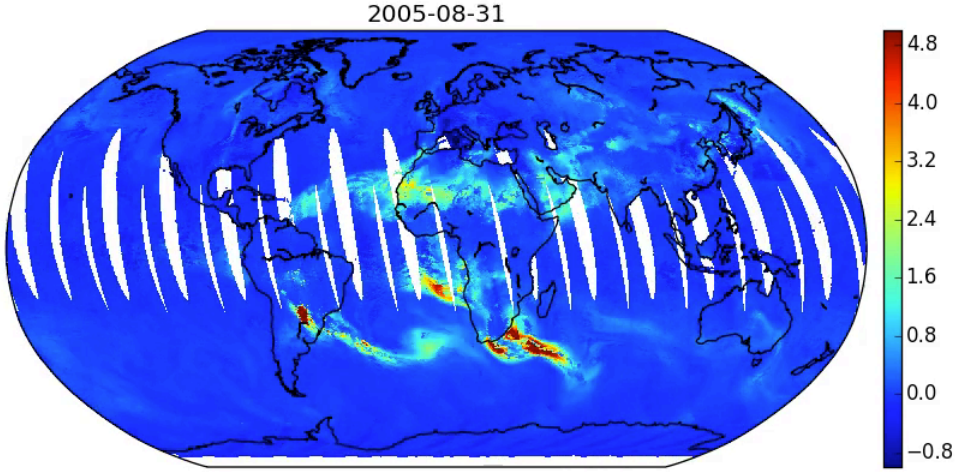
GOCART

- A global atmospheric process model using assimilated meteorological fields from the Goddard Earth Observing System Data Assimilation System
- Aerosol simulations in GOCART include the major aerosol types of sea salt, sulfate, dust, black carbon, organic carbon
- The model accounts for emissions from fossil fuel and biofuel combustion, biomass burning, volcanic eruptions, vegetation, deserts, and oceans.
- Calculating aerosol composition, 4-D distributions, optical properties, radiative forcing, etc.
- See Chin et al., Atmos. Chem. Phys., 14, 3657–3690, 2014, and references therein.

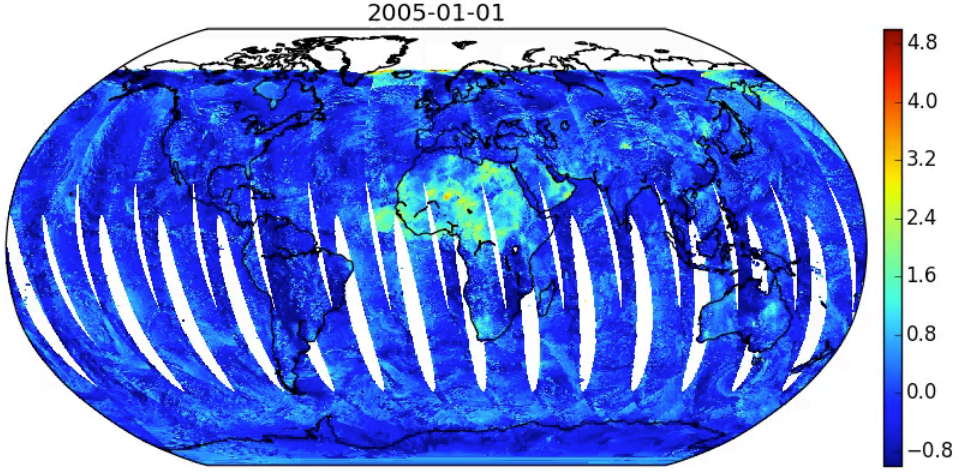
OMI



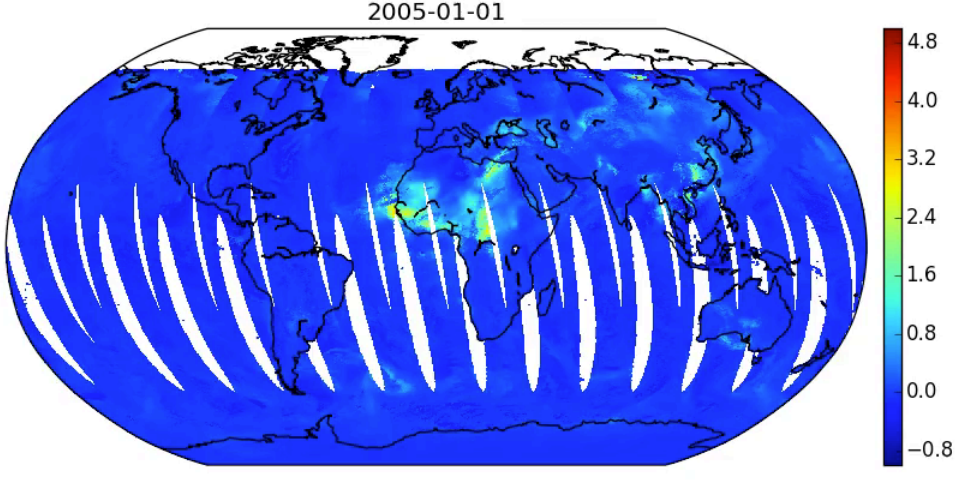
SIM



OMI

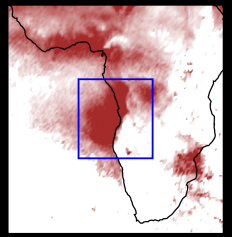


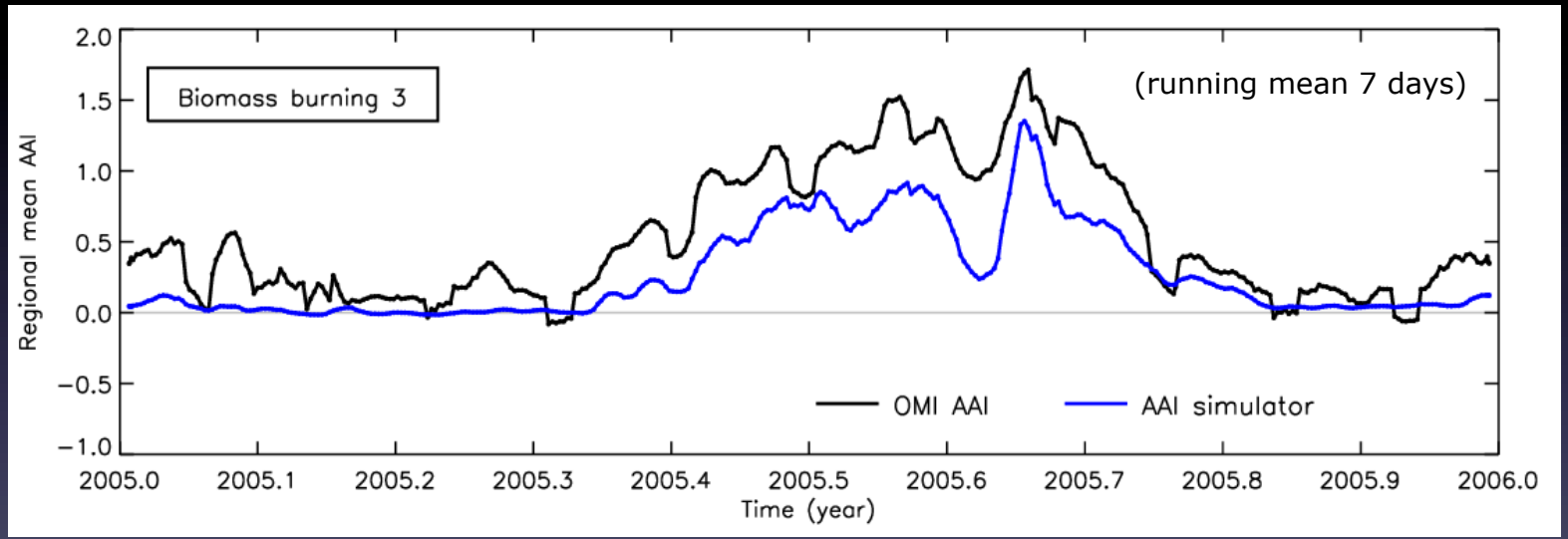
GOCART + SIM



West Africa (biomass burning)

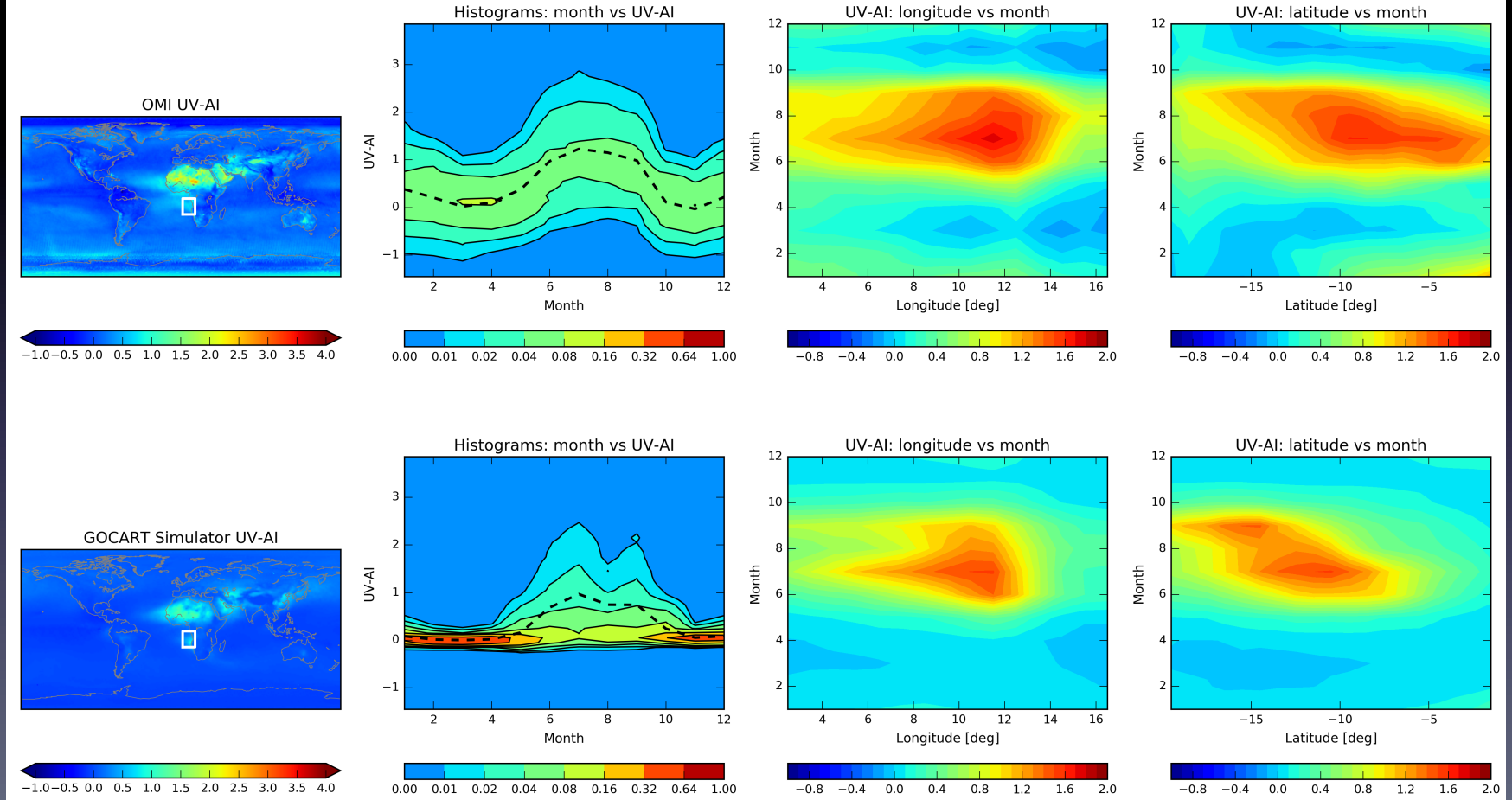
Regional mean of OMI AAI and of simulator AAI:

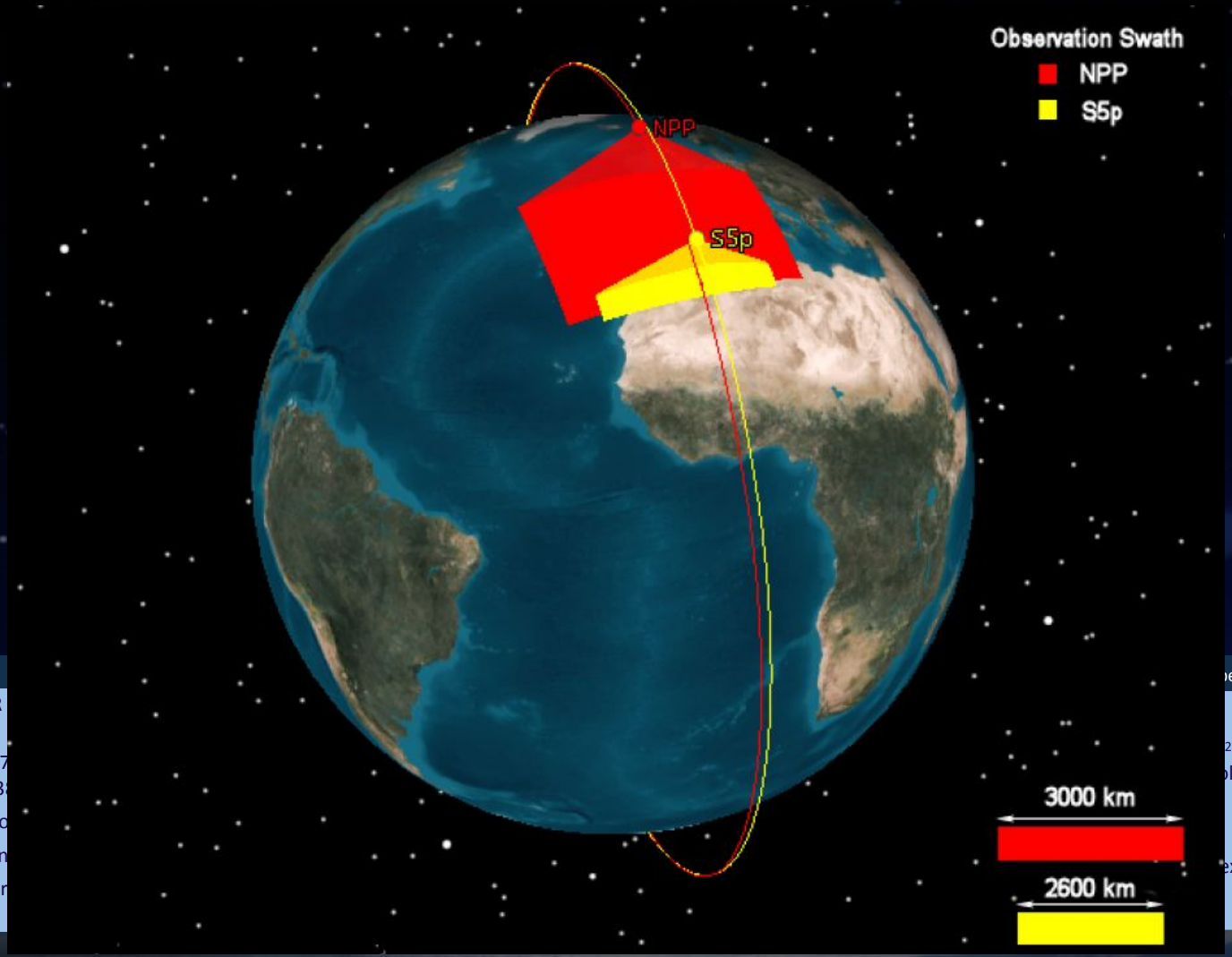




There is quite some agreement, even on shorter time scales. Absolute magnitude is not captured completely. The simulator underestimates the AAI values reached.

West Africa (biomass burning)





TROPOMI

- UV-VIS-NIR-SWIR spectrometer.
- Spectral range: 27 675-775, 2305-23
- Spectral Resolutio
- Spatial Resolution
- Global daily cover time.

ernicus

$_2$,CH_4, HCHO
olumn

ex & Aerosol layer height

Summary

- The UV spectrometers can provide information on absorbing aerosol plumes.
- The UV AI has strong dependency on the absorption, the concentration and height of aerosols.
- We can use the UV observations in a quantitative way:
  - For biomass burning plumes over clouds
  - Using simulators
- At KNMI we will extend the UV AI with the European UVN spectrometers: TROPOMI, Sentinel 4 and Sentinel 5
  - For these instrument we are also developing aerosol layer height retrievals